LUBRICATION

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EDITORIAL

The man who has bought Liberty bonds, even though valued at thousands of dollars, can aid very materially in winning the war by lending his spare quarters to Uncle Sam. The workman who found it impossible to buy even a $50 Liberty bond can certainly carry a thrift card and can now and then invest 25 cents in a thrift stamp, or $4.17 in a War Savings Stamp, which, on January 1, 1923, will be redeemed for $5.00 or at any time before this date at full purchase price and interest. Even the children can perform a triple service by investing the pennies and nickels stored up in their banks in thrift stamps. This will put small coins into circulation; will help to win the war; and war savings stamps purchased with this money will draw interest.

NOTICE

It is desired to call the attention of young men who have had technical training and experience to the fact that their abilities can best be put at the service of the country by selecting a branch of service in which their special qualifications will be of the greatest use.

The Submarine Force of the United States Navy requires the services, as officers on board submarines, of young men who have had technical training in mechanical and electrical engineering and who have had experience in these professions. It is intended to enroll a number of such men as provisional ensigns in the Naval Reserve Force, give them a course of instruction in deck duties at Annapolis and a course in submarine work at New London. Those who successfully pass these courses will then be sent on board submarines for regular duty.

It is requested that any men who desire this duty and who are qualified as below outlined send their names and addresses to the Commander Submarine Force, U. S. S. CHICAGO, care of Postmaster, New York.

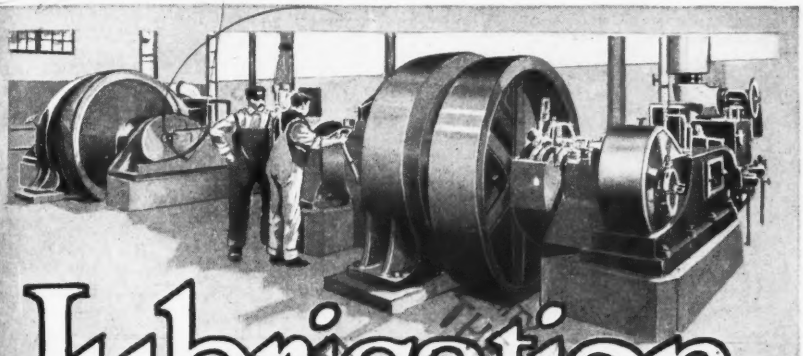
Qualifications required:

Desire to serve in Submarines.
Degree of M.E., E.E., or E.M.
Two and a half years' practical experience in profession.
Not over 35 years old.
Physically strong and sound.

Candidates should, if practicable, receive the indorsement of one of the following organizations:

Naval Consulting Board.
National Research Council.
American Society of Mechanical Engineers.
American Institute of Electrical Engineers.
American Institute of Mining Engineers.

CONANT TAYLOR,
Lieutenant-Commander, U. S. Navy,
Senior Member.
By direction
Commander Submarine Force,
U. S. Atlantic Fleet.



Lubrication

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By The Lubrication Engineers Association

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The Lubrication Engineer and His Duties
By Geo. R. Rowland

The Effect of Circulating Water Temperatures on Lubricating Oil

Gas Engine Trouble Remedied by the Use of Proper Oil

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THE LUBRICATION OF MACHINE SHOP EQUIPMENT

By The Lubrication Engineers Association

SINCE the opening of the European War, with its demand for enormous quantities of war material, there have been built throughout the United States machine shops covering many acres. Hundreds of old shops have been reconstructed, new equipment purchased and installed, and the shops put in up-to-date condition for the production of munitions and war material on an efficient, large scale production basis. The old time machine shop, dark and gloomy, with its few windows covered with grime and cob-webs, its tools dirty, worn and inaccurate, the ceilings lined with long shafts and with innumerable belts, has been forced to give way to the modern shop, full of light, clean, and equipped with modern tools kept in good condition and operated by trained men and women. Everything connected with the shop has been changed to meet the demand for maximum production; the type of machines, the method of doing the work, the handling of the material, the shop organization, the cutting tools, steel and even lubricants, have all been changed to keep pace with the times.

It might seem to many that the lubrication of machine shop equipment is unimportant as compared with the problems of production, but if accurate work is required and if maximum production is demanded, it is quite necessary that the machines themselves and all of the mechanical equipment connected with their operation be efficiently lubricated in the most modern manner. Beginning with the cutting tool which actually shapes the metal, and working back through the bearings and gears of the machine, thence through the drive gears from the motor, through belts or silent chain drives to line shafting, to the prime mover, we will consider the effect which lubrication has and how the best lubrication may be secured.

The life of a tool depends upon the material from which it is made, the character of the work which it does, the quality of the lubricant or coolant and the condition of the machine in which it is used.

The functions of cutting lubricants may be classified as follows: to cool the cutting tool and the work, to lubricate the tool and allow the chips to slide easily from its tip, to wash away the chips, to produce a good finish on the work, and to protect the parts from rust and corrosion. The subject of cutting oils and their uses is a broad one and should be dealt with in greater detail than is possible within the limited scope of this article.

As the condition of the machine in which the tool is used is more or less dependent upon the efficiency of the lubrication of its working parts, the machine shop foreman who is interested in securing maximum life from his tools and machines will want to know the best methods of lubrication. The parts of any machine tool which require lubrication may be divided into two general classes—bearings and gears—each of which need lubricants having entirely different characteristics.

In this day of high speed machines which are required to turn out high grade work to the ten-thousandth part of an inch, bearings are care-

fully designed and are, necessarily, very carefully fitted, with exceedingly small clearances. Any appreciable wear on the bearings of high-speed grinders or automatic lathes, for instance, will throw the parts out of alignment sufficiently to destroy the precision with which work can be produced and necessitate a complete overhauling and readjustment. To prevent this wear and permit a machine to turn out the maximum production of perfect work, the lubricants used should be of the highest quality, light in body and free from any gumming tendency. Heavy oils in the bearings of such machines will cause them to run hot and may even cause seizure. For such machine tools as the heavy planer, heavy duty engine lathes and rough boring mills, where the work is not so fine and bearing clearances not so small, a medium bodied oil will give better results.

Many types of automatic turret lathes, thread cutting and screw machines are lubricated throughout with the oil used for lubricating the tool and on such installations it is necessary that the lubricant used for cutting purposes have qualities suitable for bearing lubrication. On these machines where the cutting oil is reclaimed and re-used, special attention should be given to its careful filtration to remove all particles of metal which get into the oil during the cutting process. If the machines are equipped with individual pumps and circulating systems, very fine strainers or filters should be used to clean the oil as well as possible before it is delivered to the bearings. It is evident, of course, that small bits of metal carried into the finely adjusted bearings of an automatic turret lathe, for instance, will rapidly cut them out and destroy the machine as far as the production of accurate gauge work is concerned. Where a number of machines have a common circulating system for the cutting tool and bearing lubrication, a central pumping and filtration unit is provided. The best type of filters and settling tanks should be used and the oil thoroughly cleaned and made as good as new before being delivered to the bearings.

Many machine tools are now equipped with ball bearings on which only high grade oils should be used. The highly polished surfaces of the balls and races are very susceptible to the action of even weak acids, and if perfect work is desired the oil should be entirely free from acids or substances which will produce free acid in operation. Free acid has a pitting action on these highly polished surfaces and renders them liable to wear, which although slight, will have the effect of throwing the machine sufficiently out of alignment to produce inaccurate work.

Everyone is familiar with the deafening, ear-splitting noises of practically all machine shops and while some of it is, of course, unavoidable, a very large portion of it which is due to the clashing of gear teeth, may be greatly reduced. Most machine tools have gears for changing the speeds of the various parts. If these gears are spur or beveled no matter how nicely they may be cut or how accurately they may be adjusted, there is always a certain amount of "ring" or noise due to the meshing of the teeth. If a lubricant is used which will prevent actual metallic contact of the teeth, this "ring" and metallic clashing may be very much reduced and sometimes almost entirely eliminated. The noise of gears which reverse, such as those

on planers, is caused by the clashing of the teeth when the direction of rotation is suddenly changed and may be considerably reduced if a lubricating film of sufficient thickness is maintained on the gear teeth.

With the advent of the electric motor for direct drive of machine tools, a new source of noise has been brought into the machine shop. In most cases, the speed of the machine tool is very much less than that of the motor, and one, two and sometimes three speed reductions through gears are required. The smaller of these gears and pinions running at a comparatively high speed have a "ring" which it seems almost impossible to prevent but which usually may be greatly reduced by the application of a gear lubricant of sufficiently heavy body. There is also a certain amount of back lash between the gears which permits of a slight pounding or hammering of the gear teeth, particularly when the loads on the machines are changed. Sometimes it happens that the gear case enclosing these reduction gears is so designed that it forms a sort of sounding board, so to speak, greatly amplifying the actual noise produced by the gears and, in many instances, it has been found that a slight change in the method of attaching the gear case to the machine will remove this sounding board effect and reduce the noise from the gears.

The method of lubricating the machine will depend upon its design and the design of the gears. Exposed gears, such as the back gears of engine lathes, are lubricated by applying the lubricant direct to the teeth of the gears. To get the best results the lubricant should have sufficient body to keep the gear teeth from touching metal to metal, sufficient lubricating qualities to prevent wear and cutting, and the ability to stick to the gear teeth regardless of the speed of operation. Such a lubricant is Texaco Crater Compound. Machine oils and cylinder oils, while they are very good lubricants, do not have the proper body to reduce noise and have very little adhesive qualities. Greases sometimes have enough body but they are not, as a rule, adhesive, and do not stick to the gear teeth.

Many machine tools, automatic lathes for example, have the speed changing gears enclosed in an oil tight case intended for bath lubrication. Some of these gear cases include also the bearings of the gear shafts which necessarily have to be lubricated by the gear lubricant in the case. Others are so designed that the bearings are located outside of the gear case and are lubricated by oil applied through individual oil holes. In the most of these designs the gears are comparatively small, well made and properly lined up so that, unless excessive bearing wear takes place, lubrication can be secured through the use of a liquid lubricant having sufficient body to prevent metallic contact of gears and, at the same time, being thin enough to lubricate the bearings within the gear case. It should not be so heavy as to cause an appreciable power loss because of the friction of the gears moving through the lubricant in the case. Texaco Thuban Compound meets these conditions admirably.

Other types of machine tools are equipped with circulating oiling systems which provide continuous lubrication for the gears in the same manner as that supplying oil to the bearings. If the gears are light, nicely made and properly adjusted, and if the oil used has a fairly good body, there should be no

difficulty at all with the lubrication.

Electric drives, wherever possible, should be enclosed in oil tight cases so as to permit of a bath lubrication of the gears. An oil tight case with the proper level of lubricant will afford continuous gear lubrication and will require attention in the way of lubrication only at long intervals; once the gear case is properly supplied with a lubricant no further attention will be required for many months. Such a design is not only safer for the workman but will present a neater appearance and will generally improve the efficiency of the machine through better gear lubrication, and the efficiency of the workman by removing the nerve-racking gear noise.

Turning now to the lubrication of other machine shop equipment, we will consider first the requirements of line and counter shafting. The bearings for this shafting may be of babbitt, bronze, the several types of oil-less bearings, ball and roller bearings. Overhead shafting should be equipped with bearings designed to prevent leakage of the lubricant, and a good grade medium bodied machine oil will give satisfactory results where the bearing is so designed. Many types of bearings require a grease, because of the nature of the bearing itself, and such greases should be smooth, homogeneous, free from non-lubricating fillers and so intimately mixed in the process of manufacture that they will not separate during use. A number of ball bearing manufacturers are now building very satisfactory bearings for line shafting which may be lubricated with either a grease or an oil, and the lubricant, in each case, should be of the very best grade possible to secure.

The electric motor which is being widely used for line shaft and individual drives, presents very little difficulty when the proper grade of oil is used. If the oil is low in volatility so as to prevent excessive amounts vaporizing and being carried into the field coils or armatures by the air currents; if it has good lubricating qualities and is of the proper viscosity, there should be no bearing trouble. Ring oil bearings require little attention if filled with clean oil at regular intervals.

Many of these details are so easy to overlook in the attempt to get out maximum production that they do not receive the attention which they should, but because of the benefits to be derived from the use of suitable lubricants, in the increased life of machines and tools, there seems to be much to be gained by the machine shop owner, through insistence upon good lubrication.

LUBRICATION OF LAIDLAW FEATHER VALVE AIR COMPRESSORS

THE question of lubrication of air compressors has been given more than usual study in recent years. This has been due in a large part to the necessity, in these days of severe competition, for greater economy in the use of oil than that provided by older types of oiling systems. Furthermore the development of high speed automatic air valves has so increased the operating speeds of the modern air compressor that more efficient methods of lubrication have become a necessity.

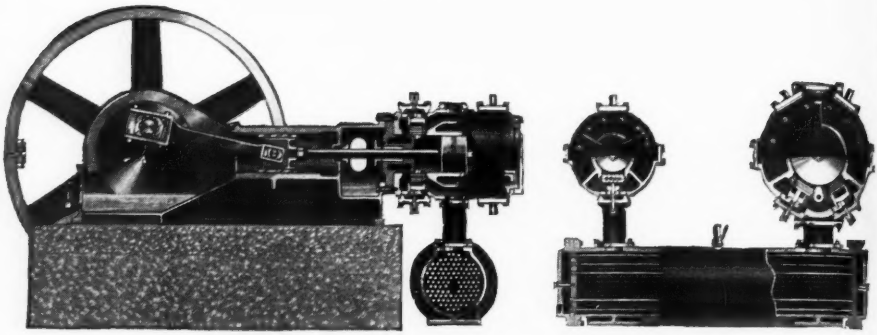


Figure 1—Sectional View, Laidlaw Feather Valve Air Compressor

In either case the underlying factor is the same, viz., the necessity of reducing the cost of producing power, brought about by extreme competition.

The old system of individual oil cups, while giving fair lubricating results on the old style slow moving compressor is very wasteful in the use of oil. With this system oil is allowed to flow drop by drop onto the rubbing surfaces and then run down over the machine, frequently soaking the foundations and completely going to waste. The oil after being once used is never recovered. As a consequence the oil consumption of a compressor of this type becomes quite a large item of the total operating cost.

With the coming of the high speed compressor it was obvious that the wearing parts demanded a lubricating system different from that provided by small individual cups. The natural development was, therefore, toward some system by which the bearing parts would at all times be flooded with oil, permitting the lubricating oil to be used over and over without waste. The lubricating system used on Laidlaw Feather Valve Air Compressors is shown by figure one. The frames are of the completely enclosed type arranged for automatic lubrication of all its bearings. It will be noted that the crank pit of the frame forms the oil reservoir into which the crank dips. During operation the oil is thrown in large quantities over all the working parts, so that the bearings are literally flooded with oil at all times. The frame is so arranged that the oil drains back to the crank pit to be used over and over as in the case of automatic engines. The only attention required is a daily inspection of the oil level, which is indicated by a gauge glass on the outside of the crank case.

The inside surfaces of the frame which come in contact with the oil are very thoroughly cleaned, after which they are white enameled which prevents any small particles of metal from mixing with the oil. At regular periods all the oil should be drained from the crank case and thoroughly filtered after which it may be put back with such additional amount of fresh oil as is necessary. It will be noted from Figure 1 that an intermediate head is located in the frame guide so as to form a chamber between the frame reservoir and the cylinder head stuffing box, this chamber being provided with a drain. The use of this intermediate head is especially important as it prevents

Figure 2—Enclosed Self-oiling Feather Valve Compressor

condensed steam from the steam cylinder stuffing box from mixing with the lubricating oil, thus preventing the possibility of forming an emulsion.

It will be observed that the lubricating system used on Laidlaw Feather Valve Compressors wastes no oil. The cost of oil, which is quite a large item of operating expense with the usual air compressor, is reduced to a small fraction of the cost where the usual open frame oiling system is employed. On the other hand because of the copious lubrication provided, the wear on the bearing parts is very greatly reduced with a corresponding reduction in mechanical operating friction. Compressors have been in service for one to two years with the original tool marks still on the crosshead guide, proving that the amount of wear has been very slight indeed.

The entire frame and running gear are completely enclosed with oil tight covers, thus eliminating the unsightly oily condition of many types of compressors. The outer appearance of the Laidlaw Enclosed Self-Oiling Feather Valve Compressor is shown by figure 2 which illustrates a 2,000 cubic foot direct motor driven compressor.

The oil economy of the air end has been also very greatly improved by the use of the Laidlaw Feather Air Valve. By the use of this valve the oil consumption of a compressor cylinder may be reduced to a minimum demanded by the piston rings for cylinder wall lubrication. Other forms of air valves require a much greater amount of oil, especially the mechanically moved and the so-called semi-rotary Corliss type valve which require careful lubrication and a comparatively large quantity of oil for their satisfactory operation.

The construction of the Laidlaw Feather Valve is shown in detail by figure 3. It is considered the lightest and most flexible air valve in use today. There is only one moving part, the valve strip itself. These are of light steel, and are permitted to lift free from the seat in their middle section by the curved valve guard to allow the passage of air. The valve is of the utmost simplicity as can readily be seen, and is not exacting in its requirements of materials, which is fortunate, since it is almost impossible to obtain in the present market

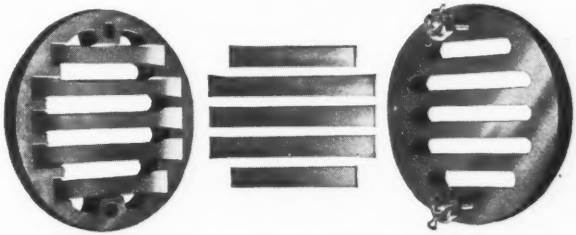


Figure 3—Laidlaw Feather Valve

special materials uniformly testing to rigid specifications.

It is obvious that in its operation the valve requires no lubrication. As the ends of the strips are restrained from leaving the seat by the curved guard, the valve seats by increase in point of contact beginning at the ends and extending to the middle. Besides relieving the usual destructive impact incident to valve action, the contact closing greatly reduces valve leakage. The elimination of the closing impact permits the use of a valve lift considerably higher than that possible with the usual type of so-called plate valve. In fact the valve can and does in normal operation lift sufficiently to give opening through the double ported lift equal to the area of its seat, whereas the lift area is frequently restricted to less than half the seat area.

Laidlaw Feather Valve Compressors are built in various sizes and types. Quite a few are direct coupled to oil engines, making a most desirable unit where oil is a cheaper fuel than either coal or electricity.

We recommend Texaco Regal Oil for the lubrication of this air compressor.

THE LUBRICATION ENGINEER AND HIS DUTIES*

By Geo. R. Rowland

SINCE our last Engineers' Meeting there has been a decided change in the personnel of our organization. Many who were with us then are absent to-day, having been assigned to other departments or, as is the case with the majority, having gone into Government service. On the other hand we have with us a considerable number of new engineers, whom this meeting affords us the first opportunity to welcome generally into the Department.

In all industry of the present day and particularly in the oil business the engineer plays a large part. Perhaps not enough consideration has been given to the importance of the part he will have in the future in development of lubrication matters in this country. That the value of the engineers to our own company is recognized by the executives is evidenced by their approval of maintaining the force and by their confidence in the Department in placing in our hands the negotiations for the handling of some of the largest business the company enjoys; and to uphold this responsibility not only must there be co-operation on the part of all of the engineers but each engineer must assume individual responsibility as a factor for accomplishing the desired results. The engineer as an individual may enhance the value of the Technical Department and justify its prestige by efficiently and carefully performing any work that is assigned to him, giving close attention to details and embodying in his reports all of the information he acquires in connection with his work.

It is essential that the engineer in order to advance the interests of his department first inform himself as to what work will prove the most profitable from the standpoint of the department, and then consider

* From a paper delivered at the annual meeting of The Lubrication Engineers Association of The Texas Company, held at New York, May 27-29, 1918.

himself absolutely a unit for the performance of that work in harmony with the general scheme of accomplishment. In order to attain his greatest efficiency the engineer should enter upon his duties with the attitude that this is to be his life work. He should make up his mind to study the business in its most minute details, advancing with the times and taking advantage of every opportunity to develop all of the information possible relating to the subject of lubrication. He should be willing to lay aside personal considerations to a great extent, particularly as regards the necessity of absence from home a considerable part of the time, which is one of the usual requirements of his work. He should consider it his duty to co-operate not only with his superiors but with all concerned in the lubricating affairs of the company. He should add anything he possibly can to our fund of information, turning in to the office from day to day in the form of detailed and intelligent reports any data he has had an opportunity to acquire, appreciating that whatever information he may develop in connection with his work is not to be regarded as personal property but as his contribution to the department's records. . . .

The selection of engineers qualified to develop the work of the Technical Department with its diversified duties is a matter of considerable responsibility. It is often the case that men who are unquestionably expert engineers and who have the advantage of both technical and practical experience combined with selling ability are not by any means adapted to the handling of lubrication matters. We have employed young men and middle aged men, some who have gained their education through colleges and others through practical experience only, making our selections as carefully as possible according to their fitness for the work as it appeared to us and while we have been successful in some instances in securing the highest type men suitable for our work, we have in other instances selected men in whom, based on general observation, we were justified in placing great confidence but who in time proved to be utterly unsuitable for the work. To the uninitiated it may appear that any well informed engineer, after being schooled in the characteristics and general methods of application of oils should be qualified for our work, but when the many and varied requirements of the Lubrication Engineer are considered it can readily be seen why the selection of men who will ultimately develop into just what we require is so difficult. The engineer of to-day must be qualified not only to make inspections, conduct tests and demonstrations of lubricants and determine the causes of complaints; he must be qualified to handle inquiries from customers or prospective customers for technical advice with regard to lubrication, to answer questions asked by salesmen or other representatives concerning the suitability of certain oils for certain types of machinery, based upon a general knowledge of conditions of operation as affected by the method of application of the lubricant, by speed, bearing surfaces, weight of bearings, temperatures and all other features which enter into the selection of proper lubricants to meet conditions. The engineer should be a student of all mechanical conditions and improvements, so as to be capable of acting in an advisory capacity with regard to what lubricants will enable the customer or manufacturer to de-

velop the greatest degree of efficiency at the most reasonable cost. He should also be prepared to cast aside technical and theoretical considerations and to handle the commercial side of the proposition in a most convincing manner. As it is the policy of our company to handle only the high grade and, consequently high priced, lubricants, our engineers should be possessed of tact to a degree which in combination with a thorough knowledge of the business will enable them to win the customer's assent to our proposition that he allow us to convince him by test or demonstration of the merits of our lubricants for his requirements.

In many vocations the most important feature to be considered is personality, but owing to the fact that the engineer in the oil business works for the most part with the operating men of the concerns with which he is dealing and the fact that personality does not as a rule count with this class of men or is even likely to arouse antagonism, the feature of personality becomes a secondary consideration in the selection of a lubrication engineer. The majority of operating men take the attitude that they know more about anything pertaining to the operation of their plants, lubrication matters included, than anyone else, and if approached by a representative of an oil company whose personality is too pronounced they resent his suggestions as interference to a certain extent. However, it is agreed that a combination of personality with a thorough knowledge of existing conditions and an adaptability for meeting and dealing with all classes of men is essential in a lubrication engineer, as he not only has to deal with the operating classes but has to be qualified to meet creditably the executives of the largest concerns in the country.

The Texas Company is advancing rapidly along good practical lines, and all of our men are to be congratulated upon the work they are doing. There are many instances where our men get into overalls and get down to the job themselves in order to facilitate the work when they encounter mechanical conditions that require some sort of adjustment or change to make possible the proper application of the lubricant that we recommend for that particular operation. In one instance one of our engineers encountered some difficulty in applying Crater Compound to some covered gears. He borrowed a helper and tools and with this assistance drilled holes in the guards so that Crater Compound could be properly applied. This gained for him immediate favor with the operating forces in the plant and at the same time developed for us information which we could take up with the manufacturers of the machine with the suggestion that these guards in the future be manufactured so that the lubricant may be properly applied. Another of our engineers who has a very enviable reputation in the territory he handles, is continuously being asked by the various plant owners to assist their engineers or help them out in various ways when they are in any difficulty. The engineer who uses every means of getting necessary work done, even if he has to do it himself, will soon find that he has developed a very fine reputation and has a clientele who depend upon him for solution of their problems with great confidence in his ability and judgment. Such work, which is very closely noted at this end, not only enhances the prestige of the department but adds to the

reputation of the engineer in the home office as well as in the field and leads to substantial financial returns for the company in the way of establishing permanent business relations with satisfied customers. In other words, it is not desirable to have for this work men who, though entirely practical and undoubtedly qualified as good oil men, are inclined to pose as consulting men only—who are constantly outlining things to be done for improvement of mechanical conditions and coming back to find that their suggestions have not been carried out. In these days of strenuous business and full capacity operation the plant people have but little time to devote to any work outside of that in which they are regularly engaged and we cannot expect them to be as much interested in these matters as we are or to carry out in exact detail the suggestions we make. Therefore, the engineer who can do and will do what is necessary to improve the situation will make for himself an enviable reputation and will at the end of the year have accomplished infinitely more than the engineer who, though possibly his superior in general knowledge, works in a consulting capacity only. It will generally be found that the man who is willing to carry out the work himself will be furnished with helpers and tools to do it with, and that his assistance in this line will be cordially received.

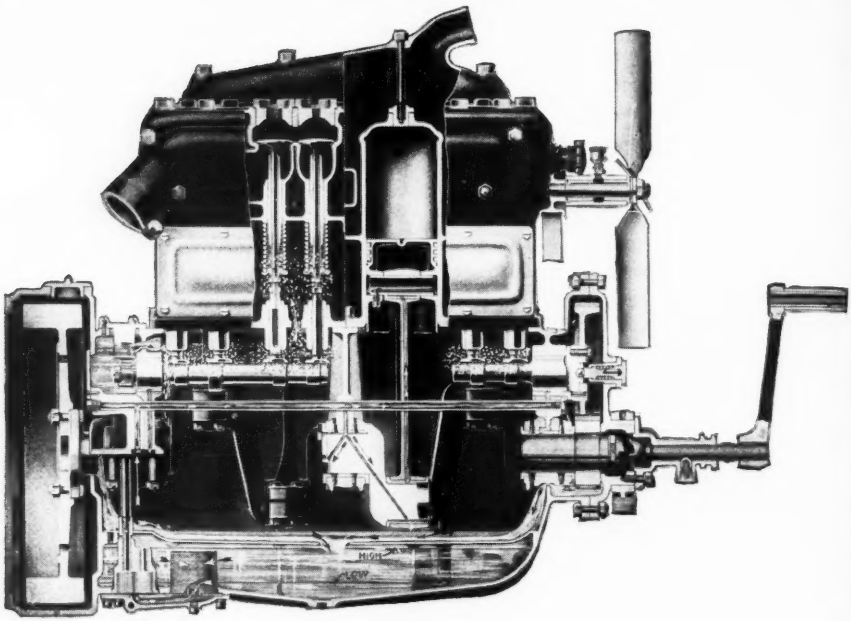
The man who knows what to do and how to do it is pre-eminently the engineer, because it is becoming clear that in the future the man who owns things is not going to be as important as the man who can do things. Our engineers should act along the line of doers of the work, keeping in mind the fact that the company does not need ambassadors, nor does it need the engineers for advertising. We have other departments for such purposes. What we expect of our engineers is service of a productive nature, commercially as well as technically.

EFFECT OF CIRCULATING WATER TEMPERATURES ON THE LUBRICATING OIL USED IN INTERNAL COMBUSTION ENGINES

IN connection with the general efforts of the automobile and tractor motor manufacturer to improve the economy of the internal combustion motor and the ease with which low grade gasoline and kerosene may be efficiently burned, a discussion of some tests recently made by The Texas Company may be of some interest as pointing out one way in which better economy might be obtained. These tests were made with the original idea of determining the effect of the temperature of the water in the circulating system on the condition of the lubricating oil.

The motor used was a Buda Type HU, 4 cylinder, 4¼″ x 5½″ as shown in the cut. This motor employs a force feed oiling system at an oil pressure of thirty pounds, the oil reservoir holding eight quarts.

In each of the runs, the crank case was thoroughly drained and flushed before the new supply of oil was put in the motor. At the end of each run the crank case was completely drained and the oil



Buda Type HU Motor

	Test No. 1	Test No. 2	
Distance traveled	15	15.1	Miles
Atmospheric temperatures	13	12	Deg. F.
Circulating water temperature	180	102	Deg. F.
Temperature of oil at finish	91	82	Deg. F.
Oil put in	8	8	Quarts
Oil taken out at end of test	7¾	8	Quarts
Oil consumption	¼	0	Quarts
Reduction in viscosity of oil	26.3	48.3	Per cent.

reclaimed and accurately measured, the difference between this quantity and the amount originally put in representing the consumption. The temperature of the crank case was also taken at this time immediately after the close of the run.

The first test was made with the entire radiator front blocked by a sheet of cardboard and the radiator filled with hot water. The second test was made by removing the cardboard and filling the radiator at the start with cold water. A medium bodied motor oil was used for both tests.

The prevailing idea as to the relation between the temperature of the motor and the character of the lubricating oil which can be used successfully, has always been that a hot motor thinned the oil down rapidly and that a heavier bodied oil was required than for a colder motor. This is, of course, entirely true when the effect of heat is considered alone and if complete vaporization and combustion of the fuel is secured. General recommendations, based on experience with motors burning completely vaporized fuels, would be to the effect that a high circulating water temperature with resultant high motor temperatures would require the use of a heavier bodied oil in order

to maintain the piston seal and prevent leakage of gas on the explosion and compression strokes than would be needed if a lower circulating water temperature were maintained. High grade gasolines are easily vaporized and there is comparatively little condensation of heavy ends in the cylinder.

When it became necessary to use lower grade gasolines and kerosenes, the subject of carburetion began to receive the attention of all designers interested in motor economy, and while carburetion methods have been greatly improved, most of them depend, to a considerable extent, upon the heat of compression in the cylinder to complete the vaporization of the fuel. When the partially vaporized fuel passes into the cylinder the liquid portions or heavy ends condense on the cylinder walls and tend to wash the lubricating oil off the cylinder walls, and unless the fuel is vaporized by the heat of the motor and completely burned on the firing stroke, a waste of fuel and a destruction of the lubricating oil in the crank case will result.

The test made with a circulating water temperature of 180° F. showed a lubricating oil consumption of one-fourth quart, and a reduction in viscosity of the oil of only 26.3% due to the contamination and thinning down of the oil by the liquid fuel. The test made with a circulating water temperature of 102° F. indicated that the leakage of condensed fuel into the crank case not only kept pace with the consumption of lubricating oil, but also reduced the viscosity of the remaining oil 48.3%. If the amount of oil remaining in the crank case were the same after each test the difference in viscosity of the oil alone would indicate a loss of about twice as much fuel when the motor was operating at a low temperature as was lost when the motor was hot.

Owing to the lack of accurate information as to the exact temperature of the inner cylinder wall where the oil film is placed, it is impossible to compare the working viscosity of the oil under these two conditions, but it is safe to say that the viscosity with the circulating water at 180° F. is much lower than with the water at 102° F. In spite of the thinner oil film the leakage of fuel into the crank case was far less than when the oil film was thicker at the lower temperature.

These tests show very clearly the bad effect on the lubricating oil of unvaporized fuel in the cylinder and emphasize very strongly the importance of reducing the fuel leakage to a minimum. Whether the complete combustion of all the fuel is secured thru complete vaporization outside of the cylinder or inside it, the advantages to be gained are obvious. Any method of supplying fuel to the cylinder, free from liquid or unvaporized particles will undoubtedly prevent the greater part of the present destruction of the lubricating oil and at the same time improve the economy of the motor.

On the other hand, if carburetors are employed which do not completely vaporize the fuel, it would appear from these tests that the fuel loss may be reduced by the use of higher circulating water temperatures. There is probably a definite temperature at which any motor will operate most efficiently and if tests indicate that this temperature is high, say between 175° F. and 200° F., close attention should be given to the circulating system, as such high temperatures are sometimes dangerous unless the system has been so designed as to be free from pockets where vapor might collect or hot spots where

steam might be formed. It is also advisable to automatically maintain the desired temperature and prevent excessively high temperatures by means of some sort of temperature controlling device.

The best results secured from the hot motor reduced the viscosity of the oil 26.3% which is higher than is desirable for such a short run and is due to the fact that a medium bodied motor oil was used.

GAS ENGINE TROUBLE REMEDIED BY THE USE OF PROPER OIL

IN the November 1st, 1917, issue of *Power Plant Engineering*, there appeared the following letter:

CAN YOU SUGGEST A REMEDY?

We have a 12 h.p., 3 cycle, vertical gas engine, which has been in service for about ten years. During all this time it has received good attention, but for the past year we have had complaint of requiring more frequent replenishing of the oil supply in the crank case, the oil working up past the pistons. We also installed a 2 cycle vertical, 20 h.p. only a year ago and in one or two hours operation so much oil will work past the pistons that it will ooze out around the igniters and drown out the igniters until they fail to operate.

We have tried lowering the height of the oil in the crank case in these engines to almost the danger point and have put new rings on the pistons, but with no improvement.

On a recent visit to another city, I stepped into a plant where there was a 4-cycle vertical engine, which was being dismantled to clean the oil off the pistons and cylinders and I was told this was a common occurrence, altho this engine has been in service a little more than a year.

Can any of the readers give us a remedy for this trouble?

WEST VIRGINIA TRACTION & ELECTRIC CO.
C. E. N.

In the December 1st and December 15th issues of this magazine, a number of readers offered suggestions as to how this trouble might be overcome; the most of them making the suggestion that it would probably be necessary to rebore the cylinders.

After reading these comments, our engineering division decided that there was a possibility that the trouble was due to unsuitable oil, rather than worn cylinders or mechanical trouble with the engine, and one of our expert lubrication engineers was therefore requested to call on Mr. Nigh, and upon examining the engine, made the following report, and arranged for a test of Texaco Alcaid Oil.

WEST VIRGINIA TRACTION & ELECTRIC CO.,

MORGANTOWN, W. VA.
February 11, 1918.

Started test of Texaco Alcaid Oil this morning. The Cook Motor is of the French Type having double expanding pistons, and is splash lubricated with cup feed for external bearings. Size 20 h.p., running 350 r. p. m., using natural gas which is very lean and carries considerable moisture that is sure to find its way into the crank case. They have not been able to run this motor as the trouble was caused by oil working past the pistons and forming a hard carbon which they claim causes pre-ignition.

Texaco Alcaid Oil was placed in the crank case, the motor started and ran for two hours without load. Then full load was put on. After adjusting feed water and air supply the engine was run for five hours. Temperature of the crank case was taken at intervals of every half hour, running with the case closed, and the temperature showed an increase of 40 degrees F. in four hours. At this time the writer put in two 2″ pipes for crank case ventilation, and the oil was drawn from the case and new oil put in service. After three hours the temperature of the oil was only 2 degrees higher than when it was put in the case, and no smoke showed in the exhaust. Mr. Rinke, Chief Engineer, is very much pleased with the showing of the oil, and told me that it was

the first time since they bought the engine that they were able to run it for ten hours without fouling or trouble.

(Sgd) M. A. KRETCHMAR,
Engineer.

February 12, 1918.

This morning the writer drained the oil out of the crank case of the motor and started the engine to see the amount of vapor in the case. The piston had contracted and allowed considerable space, and the vapor was quite noticeable. The Engineer said, "I can see that an oil will need to be drawn off at least once a month." I told him that would help, of course, but that the best practice would be to start his engine and not put on the circulating water at full force for at least a few minutes, and then bring it up to full feed when he felt the water was getting warm. They had been in the habit of turning on the water at full force and then starting the engine. We then put the oil in again and ran all day without any bother or trouble. I do not see that I can do any more here as this unit is in first class order and the engineer said that he was more than satisfied. So will call on Mr. Rinke in the morning and suggest that he give me an order for one barrel of Texaco Alcaid Oil so that he can try out same on the Gas Engine.

(Sgd) M. A. KRETCHMAR,
Lubrication Engineer.

This engine is a Cook Gas Engine built by the Cook Motor Company, Delaware, Ohio, U. S. A., two cylinder, 20 h. p. motor 4 cycle, water cooled of the hit or miss type. The fuel is taken from a double seated admission valve, the intake valve remaining open for the entire stroke and then compressing to high temperature. The ignition takes place from a jump spark, the timer being regulated by hand lever. The three features about this engine are the throttling governor, the positive fuel oil feed and the hinged connecting rod. The two cylinders are set to explode alternately and there is no stress on the connecting rod, the pressure is always at the explosive stroke on the high compression of the opposite cylinder and that takes up the jar.

This test of Texaco Alcaid Oil was so satisfactory that Mr. C. E. Nigh wrote us the following letter:

WEST VIRGINIA TRACTION & ELECTRIC COMPANY

MORGANTOWN, W. VA.
March 6th, 1918.

THE TEXAS COMPANY,
PHILADELPHIA, PA.

GENTLEMEN:

We were unable to operate a 20 h. p. two-cylinder Gas Engine for more than an hour, the trouble being due to oil reaching the igniters. Your engineer after investigating this machine laid same to lubrication. He sent us one barrel subject to approval and we have operated this machine daily for thirty days without any trouble, and can assure you Texaco Alcaid Oil is doing all your engineer claimed for it.

Yours very truly,

WEST VA. TRACTION & ELECTRIC CO.
(Sgd) CHAS. E. NIGH,
Master Mechanic.

All it cost Mr. Nigh to put this engine into continuous operation and keep it there, was enough oil of the right grade to properly lubricate it. If some of the suggestions made had been followed on cylinder reboring, new pistons and piston rings put in, it would have cost the West Virginia Traction & Electric Company much money, and the chances are their trouble would not have been overcome. This goes to show the value of correct lubrication and the necessity for using the right grade of oil.

The services of the Texaco Engineers are gladly extended gratis to engineers or operators interested in improving the efficiency of their equipment or overcoming trouble. The importance of locating the true cause of the trouble cannot be overestimated and when it is due to improper lubrication, it is very easy to remove the wrong grade of oil and substitute the proper grade.

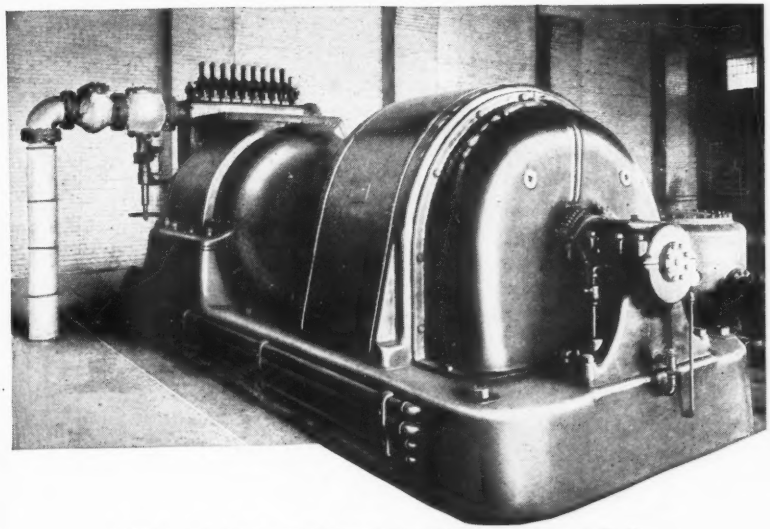
SALVAGING TOOLS IN WAR TIME

THE activity and competition in many lines of industry is now so keen that advantage must be taken of every possibility of saving, in order that this competition may be met and still leave a reasonable margin of profit after all manufacturing expenses have been paid. In war time the machine shop manager is faced with an unprecedented condition as regards both a scarcity of steel and an inadequate supply of skilled toolmakers. The demand for high-speed steel used in the production of tools for various lines of munition work has resulted in increasing the price according to the familiar principle of supply and demand; and the scarcity of toolmakers has been due both to an abnormal demand for tools and to a further depletion of the supply of men due to the draft. As a result, the provision of means for obtaining further service from cutting tools is of exceptional importance in war time, and had led many manufacturers to take advantage of this opportunity of saving, who might not have thought the incentive sufficiently great to consider the proposition in times of peace. Many of those who adopted the practice as a war measure, however, are securing such satisfactory service from their salvaged tools that there is little doubt that they will continue salvaging their high-speed steel cutting tools as a proved method of economy which is equally applicable in times of war and of peace.*

The article referred to above emphasizes the importance of the conservation of tool steels and indicates methods of salvaging tools which have become worn out. While such work is quite necessary at the present time and is of course worth while at all times, it might be especially beneficial to look into the causes of tool wear and see whether something may not be done to reduce the wear and increase the life of the tool. Such an accomplishment would go a long way toward putting off the day when it becomes necessary to send the tool to the salvage men or the scrap heap.

MANY thousands of feet of splendid wire rope are discarded every year long before it is worn out because it is not properly protected from the sulphur water, acids, etc., with which it necessarily comes in contact. The life of this delicate machinery, which consists of many small strands of wire closely interwoven, can be greatly prolonged by protecting these strands from corrosion, rust, and the rubbing friction, due to the twisting and turning of the rope in use. Sometimes a wire rope which is apparently in perfect condition is pronounced unsafe. One or more of the inner strands have snapped. The construction of wire rope precludes the possibility of repairing such a break, and this expensive machinery is perforce discarded. This is an important problem, and The Texas Company has solved it. The answer is Texaco Crater Compound. This is a rich, oily lubricant, waterproof and acid-resisting, which does not flake, drip, or peel. When applied to the exterior of the rope it penetrates to the innermost strands, thoroughly saturating even the hemp core. This saturated core acts as a reservoir for the lubricant, and under severe strain the Crater will be squeezed out between the wires, thus relieving the friction at critical times. There are records which show that wire rope lubricated with Crater Compound has lasted twice as long as the same rope under the same conditions but minus the Crater. Many users of wire rope are now accompanying their orders for rope by the stipulation that it be laid up in Crater—a wise precaution.

* *Machinery*, May, 1918, p. 779.



2,000 K. W. Curtis Turbine of the Meridian Light & Railway Company, Meridian, Miss.

FOR four years this turbine has been running with

TEXACO CETUS OIL

So when Chief Engineer F. L. Bailey, in charge of this plant, says: "Texaco Cetus Oil is safe and economical" he talks from real experience.

He says it is safe because it eliminates hot bearings.

Because it doesn't emulsify and clog up the oil pipes.

It is safe because being so uniform and free from impurities, it cannot cause corrosion of shafts and bearings.

And as this plant runs 540 hours a month, these things count.

TEXACO CETUS OIL is economical.

Mr. Bailey will tell you that they use an almost unbelievably small amount of new oil to replenish the natural losses.

Do you want a safe turbine oil?

Do you want an economical turbine oil?

Then specify

TEXACO CETUS OIL

THE ENDURING STEAM TURBINE OIL

Write for prices and particulars

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OFFICES IN PRINCIPAL CITIES

There Is a Texaco Lubricant for Every Purpose

Is There a Thrift Card in YOUR Pocket?

AS you sit and read, you thank your stars that the war IS "over there" —and not here at your doorstep. And you feel grateful to the boys in khaki who are KEEPING it and WINNING it "over there."

Turn Your Gratitude Into War Savings Stamps

The spare quarters that you invest in War Savings Stamps and Thrift Stamps help Uncle Sam to clothe, to feed and to arm those boys in khaki.

When you have accumulated sixteen Thrift Stamps, cost to you $4.00, you exchange them by paying from 13 to 23 cents, according to the month of 1918 in which you make the exchange, for a War Savings Stamp for which the Government will pay you $5.00 in January, 1923. This is equivalent to 4% interest compounded quarterly. A safe and remunerative investment.

Get a Thrift Stamp, pasted on a Thrift Card, TO-DAY—at any post-office, bank or trust company, drug, cigar or department store, or the many other places showing the W. S. S. agency sign.

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